



NOTE ON A PLASTRON (TESTUDINES, PLEURODIRA) FROM THE LOWER CRETACEOUS CRATO MEMBER, SANTANA FORMATION, BRAZIL¹

(With 3 figures)

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ABSTRACT: Up to date, turtle remains from the Early Cretaceous Santana Formation were only described from the Romualdo Member (Aptian-Albian) and four species are known: *Araripemys barreto* Price, 1973 (Pleurodira: Araripemydidae); *Santanachelys gaffneyi* Hirayama, 1998 (Cryptodira: Protostegidae); *Brasilemys josai* Lapparent de Broin, 2000 (Pleurodira: Brasilemydidae), and *Cearachelys placidoi* Gaffney, Campos & Hirayama, 2001 (Pleurodira: Bothremydidae). Here we report an incomplete plastron (MN 6745-V) from the lower section of this formation, constituted by the laminated limestone layers of the Crato Member (Aptian). Compared to other turtles from the Santana Formation, this material is referable to cf. *Araripemys* based on the presence of fontanels and the lack of a mesoplastron. It constitutes the oldest Testudines from Brazil, extending the record of *Araripemys* or a similar taxon deeper into the Aptian.

Key words: Early Cretaceous. Testudines. Pleurodira. Crato Member. Santana Formation.

RESUMO: Nota sobre um plastrão (Testudines, Pleurodira) do Membro Crato, Cretáceo Inferior, Formação Santana, Brasil.

Até o momento foram descritos restos de tartarugas do Cretáceo Inferior apenas no Membro Romualdo, unidade estratigráfica superior da Formação Santana (Aptiano-Albiano) e quatro espécies são conhecidas: *Araripemys barreto* Price, 1973 (Pleurodira: Araripemydidae); *Santanachelys gaffneyi* Hirayama, 1998 (Cryptodira: Protostegidae); *Brasilemys josai* Lapparent de Broin, 2000 (Pleurodira: Brasilemydidae) e *Cearachelys placidoi* Gaffney, Campos & Hirayama, 2001 (Pleurodira: Bothremydidae). Neste trabalho é descrito um plastrão incompleto (MN 6745-V) da parte inferior desta formação, constituída pelas camadas de calcário finamente laminado do Membro Crato (Aptiano). Comparado com outras tartarugas da Formação Santana, esse material refere-se, baseado na presença de fontanelas e ausência de mesoplastrão, a cf. *Araripemys*. Essa ocorrência constitui o registro mais antigo de Testudines do Brasil, estendendo o registro de *Araripemys* ou de um táxon similar para o Aptiano.

Palavras-chave: Cretáceo Inferior. Testudines. Pleurodira. Membro Crato. Formação Santana.

INTRODUCTION

The Araripe Basin, located in northeastern Brazil between the states of Ceará, Piauí and Pernambuco, is worldwide famous for the diverse and exquisitely well preserved fossil assemblages that are present in the Santana Formation (Fig.1) (e.g. MAISEY, 1991). This lithostratigraphic unit is subdivided into three members named, from base to top, Crato, Ipubi and Romualdo (BEURLIN, 1971). Those

layers were formed during the Lower Cretaceous (Aptian / Albian; PONS *et al.*, 1990) and have yielded several fossil reptiles such as dinosaurs, pterosaurs, and crocodylomorphs (e.g. KELLNER, 1998). Turtles are also known from the Santana Formation, but were only described from the Romualdo *lagerstätte*. Here we describe the first turtle remain from the Crato Member (Aptian, PONS *et al.*, 1990), which consists of an incomplete and isolated plastron (MN 6745-V) housed in the

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collection of the Paleovertebrate Sector of the Geology and Paleontology Department of the Museu Nacional (MN), Rio de Janeiro. The specimen was collected in one of the several quarries that are being mined around the town of Nova Olinda in the State of Ceará, northeastern Brazil.

The specimen studied here (MN 6745-V) consists of an incomplete left plastron, composed of the hyoplastron and the hypoplastron of the left side (Fig.2). It was found isolated in light-beige coloured laminated limestone from the Crato Member.

DESCRIPTION

Most specimens found in the Crato *lagerstätte* are compacted and distorted, but MN 6745-V is three dimensionally preserved, a condition similar to the material from the Romualdo Member. The bone surface is also well preserved, showing a brownish colour. Except for the posterior part of the hypoplastron, no evidence of breakage was found at the edges of both elements, indicating that they were detached from the right part of the plastron and the carapace naturally before the fossilization process.

MN 6745-V is exposed in internal view. The bone surface is rather smooth. The hyo- and hypoplastron are strongly sutured. Both are dorsoventrally flattened elements, a common feature among Testudines. The articulation surface of the hyoplastron for the entoplastron (not preserved) is very deep. Despite being somewhat fragmented, it

is possible to note that the articulation surface between the hypoplastron and the xiphiplastron (not preserved) is deep too.

Two fontanelles are clearly visible: one between the hyoplastron and the entoplastron and another between the hyoplastron and the hypoplastron, the latter being the largest. The posterior portion of the hypoplastron is broken and no xiphiplastron is preserved. However, it is very likely that a third fontanelle between those elements was also present. This specimen lacks a mesoplastron.

DISCUSSION

Until now turtle remains were only described from the Romualdo *lagerstätte*, with the following taxa known: *Araripemys barreto* Price, 1973 (Pleurodira: Araripemydidae); *Santanachelys gaffneyi* Hirayama, 1998 (Cryptodira: Protostegidae); *Brasilemys josai* Lapparent de Broin, 2000 (Pleurodira: Brasilemydidae), and *Cearachelys placidoi* Gaffney, Campos & Hirayama, 2001 (Pleurodira: Bothremydidae). Besides those there is an unnamed turtle (FR 4922) deposited in the Forschungsinstitut Senckenburg, Frankfurt, Germany, that was figured (GAFFNEY & MEYLAN, 1991) and briefly discussed in the literature (MEYLAN, 1996; LAPPARENT-DE-BROIN, 2000; GAFFNEY *et al.*, 2001) and several undescribed specimens. Although known for some time (*e.g.* KELLNER, 1998; VIANA & NEUMANN, 2002), turtle remains from the Crato Member were never described before.

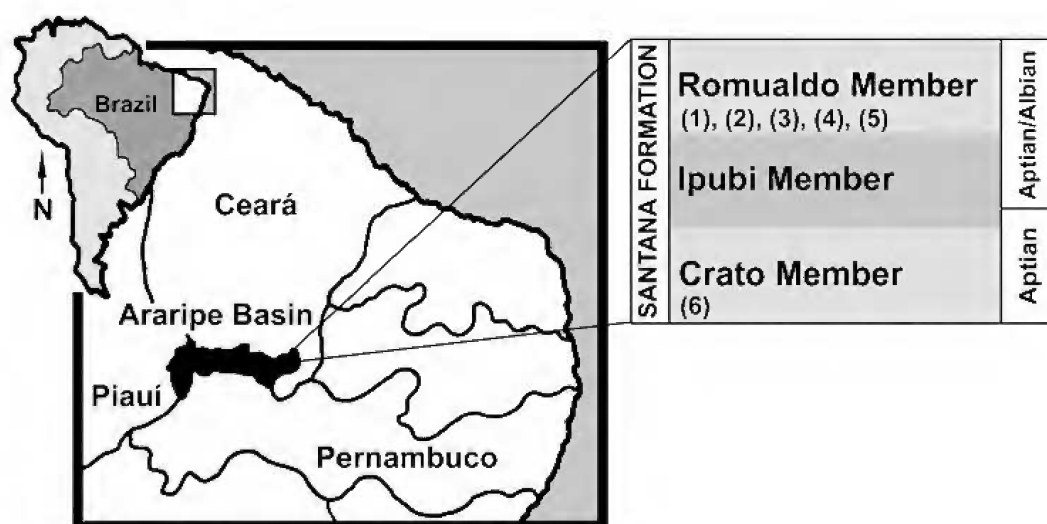


Fig. 1- Map showing the Araripe Basin and the members that form the Santana Formation. Ages based on PONTE & PONTE FILHO (1996). The numbers indicate turtle taxa recovered from those deposits as follows: (1) *Araripemys barreto*; (2) FR 4922; (3) *Santanachelys gaffneyi*; (4) *Brasilemys josai*; (5) *Cearachelys placidoi*; (6) cf. *Araripemys*.

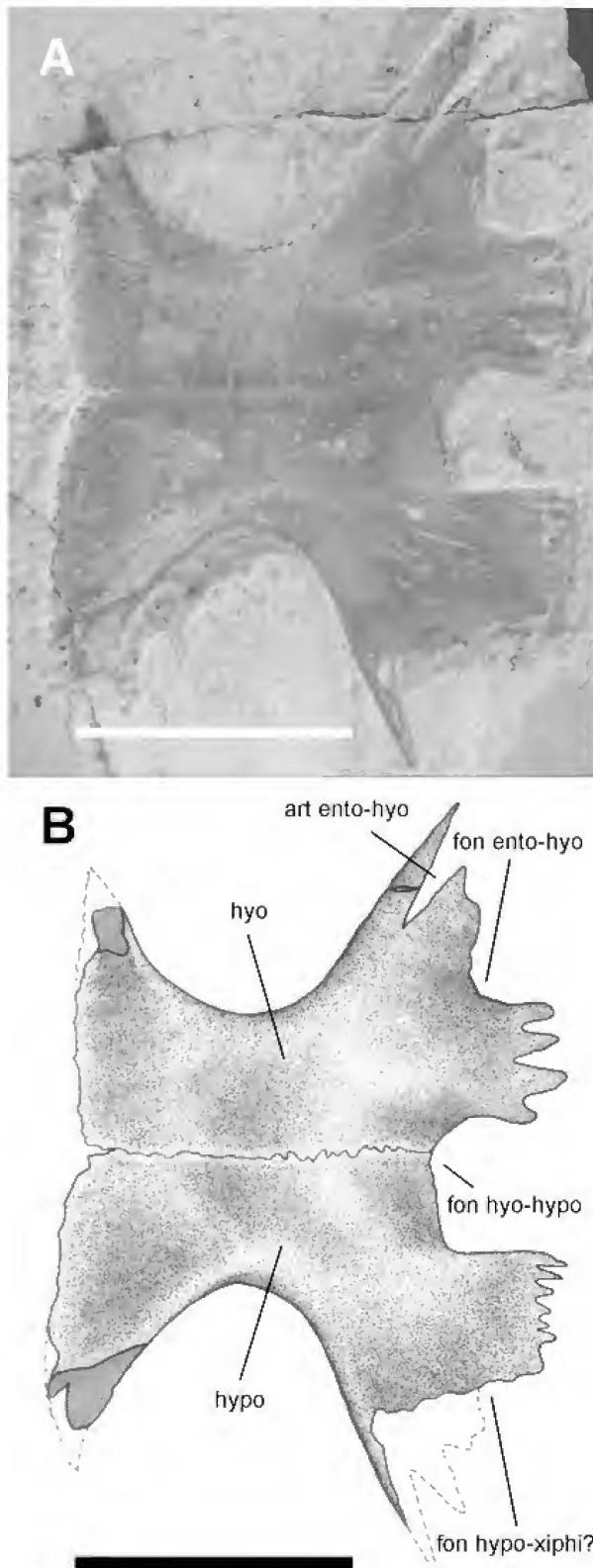


Fig.2- Internal view of cf. *Araripemys* specimen MN 6745-V. (A) photo; (B) drawing. Abbreviations: (hyo) hyoplastron; (hypo) hypoplastron; (art ento-hyo) articulation surface between entoplastron and hyoplastron; (fon ento-hyo) fontanel between entoplastron and hyoplastron; (fon hyo-hypo) fontanel between hyoplastron and hypoplastron; (fon hypo-xiphi?) fontanel between hypoplastron and xiphiplastron. Scale bar: 50mm.

Despite being incomplete, the new specimen (MN 6745-V) can be compared with the Romualdo turtles (Fig.3 and Tab.1). MN 6745-V shows at least two - and very likely three - fontanels which are absent in FR 4922 and *Cearachelys placidoi*. *Santanachelys gaffneyi* also differs from the new material since it has only one fontanel (HIRAYAMA, 1998). FR 4922, and *Cearachelys placidoi* further show the presence of a mesoplastron which is absent in MN 6745-V. Although no information of the plastron of the pelomedusoid *Brasilemys josai* is available (LAPPARENT-DE-BROIN, 2000), it possible had a reduced and lateral mesoplastron and lacked fontanels, like all other members of the Pelomedusoides (DE-LA-FUENTE, 2003). *Santanachelys gaffneyi* has a shallow articulation surface between the entoplastron and the hyoplastron, contrasting to the deeper condition found in MN 6745-V. The Crato specimen shares with *Araripemys barretoii* the presence of fontanels and the absence of a mesoplastron. Based on those features and in the absence of any main anatomical difference, the new specimen is referred to this taxon as cf. *Araripemys*.

While there is consensus among researchers regarding the depositional environment of the Romualdo layers, interpreted as an ancient lagoon, there is some controversy regarding the Crato *lagerstätte*. Most authors regard the laminated layers of the Crato Member as formed under fresh water conditions (e.g. BEURLIN, 1971; MAISEY, 1991; KELLNER, 1994) while others favor a stratified hypersaline lagoonal system (MARTILL, 1993). Therefore, the occurrence of *Araripemys* in both deposits is of considerable interest.

Since first described, *Araripemys barretoii* is regarded as a marine form (PRICE, 1973). In the Romualdo deposits, *Araripemys barretoii* is the most common turtle. There are about 30 individuals known, all of them dispersed in several public collections. However, based on the extensive collecting done in those deposits (KELLNER, 2002), the total number of specimens must be closer to 100. The Crato deposits have been extensively mined in the last decade (VIANA & NEUMANN, 2002), but so far show only a few turtle specimens, including the specimen (MN 6745-V) reported here. This difference in numbers cannot be explained by taphonomic reasons and there is no detectable bias in preservation or collecting. A similar picture is observed in fishes, where taxa common to the Romualdo *lagerstätte* are found in limited numbers in the Crato deposits (e.g. MAISEY, 1991, MARTILL & BRITO, 2000).

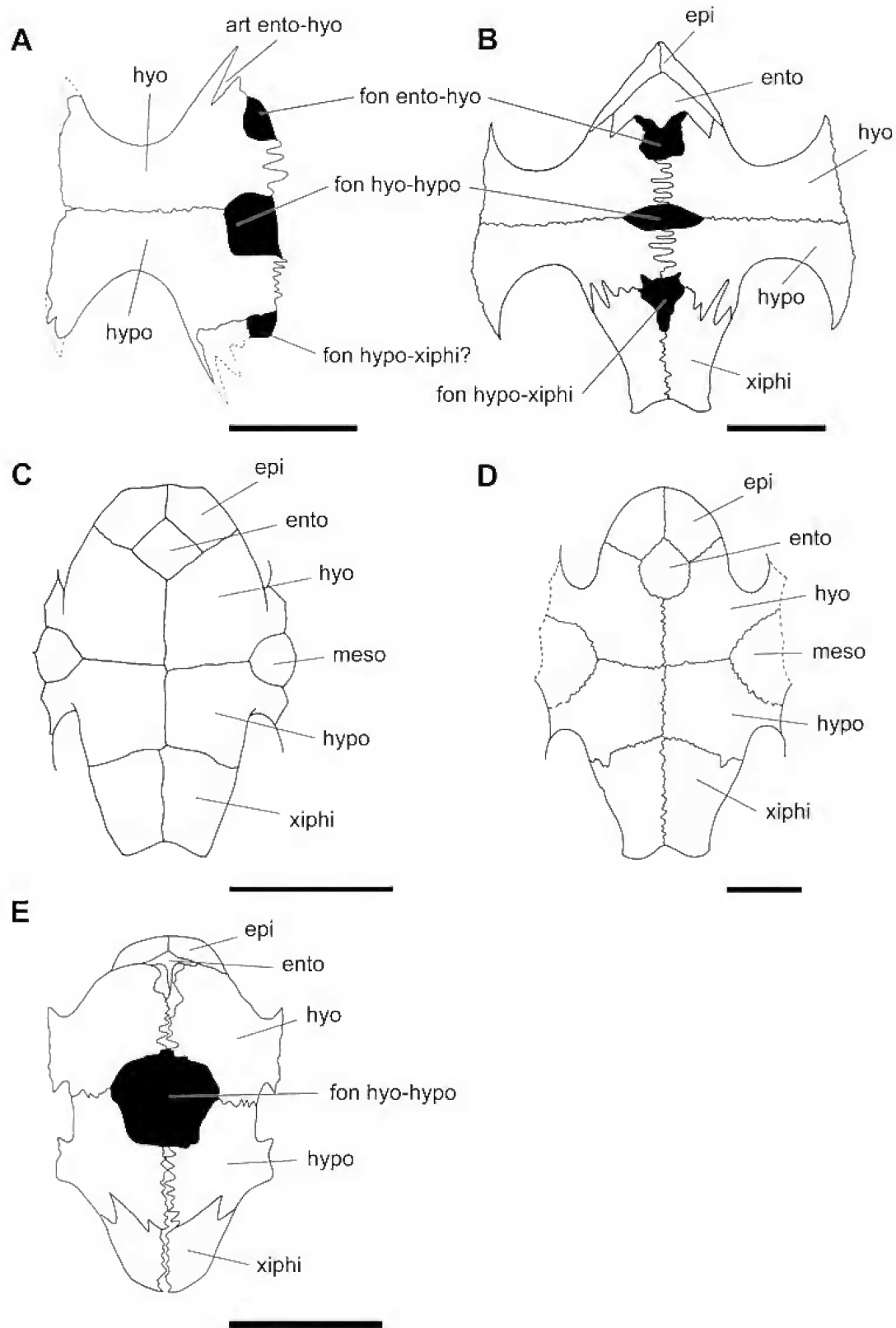


Fig.3- Comparison of the plastron from the Santana Testudines. Internal view of the (A) MN 6745-V. Ventral view of (B) *Araripemys barretoii*; (C) *Cearachelys placidoi*; (D) *Brasilemys josai*; (E) *Santanachelys gaffneyi*. Abbreviations: (epi) epiplastron; (ento) entoplastron; (hyo) hyoplastron; (hypo) hypoplastron; (xiphi) xiphiplastron; (meso) mesoplastron; (fon ento-hyo) fontanel between entoplastron and hyoplastron; (fon hyo-hypo) fontanel between hyoplastron and hypoplastron; (fon hypo-xiphi) fontanel between hypoplastron and xiphiplastron. Scale bar: 50mm.

TABLE 1. Features of the plastron of the Testudines from the Santana Formation

CHARACTER	<i>A. barretoii</i>	FR4922	<i>S. gaffneyi</i>	<i>C. placidoi</i>	MN 6745-V
Mesoplastron	absent	present	absent	present	absent
Plastral fontanelles	three	absent	one	absent	likely three
Contact ento-hyoplastral	deep	shallow	shallow	shallow	deep
Contact xiphi-hyoplastral	deep	shallow	deep	shallow	deep

There seems to be little doubt that the paleoenvironment of both deposits was quite distinct, as repeatedly pointed out in the literature (e.g. BEURLIN, 1971; MAISEY, 1991; KELLNER, 1994). The occurrence of cf. *Araripemys* in the Crato *lagerstätte* does not help to clarify if those deposits were formed under freshwater or lagoonal conditions. MARTILL & BRITO (2000) regarded the Crato deposits as representing a lagoon with high salinity where marine fishes entered occasionally. Under this scenario, other organisms that lived in salt water conditions - like *Araripemys* - might have potentially entered this lagoon as well. It is, however, also possible, that this turtle (and the fishes) occasionally entered a fresh water lake during local and sporadic marine incursions. The presence of anurans, as repeatedly pointed out in the literature, seems to favor a freshwater depositional environment and therefore the latter hypothesis is favored here.

Lastly, from the stratigraphical view, it is interesting to point out that, as Crato Member is older than the Romualdo Member (PONS *et al.*, 1990), MN 6745-V therefore extends the record of *Araripemys* or a similar taxon to the Aptian. Nevertheless, MN 6745-V is presently the oldest described Testudines known from Brazil.

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